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EP 0479317 A2 EP 0369434 A2
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(54) Abstract Title
Components for loudspeakers

(57) Loudspeakers components comprise an array of fibres 6 provided by the technique of embroidery with the fibres orientated in optimal directions to improve the sonic performance and durability of the product which may be a loudspeaker cone, the circular corrugated disc known as the spider a loudspeaker central cone, a tweeter dome or a low frequency drive dome. The fibre may be arranged radially, circumferential or in any direction selected by the designer.

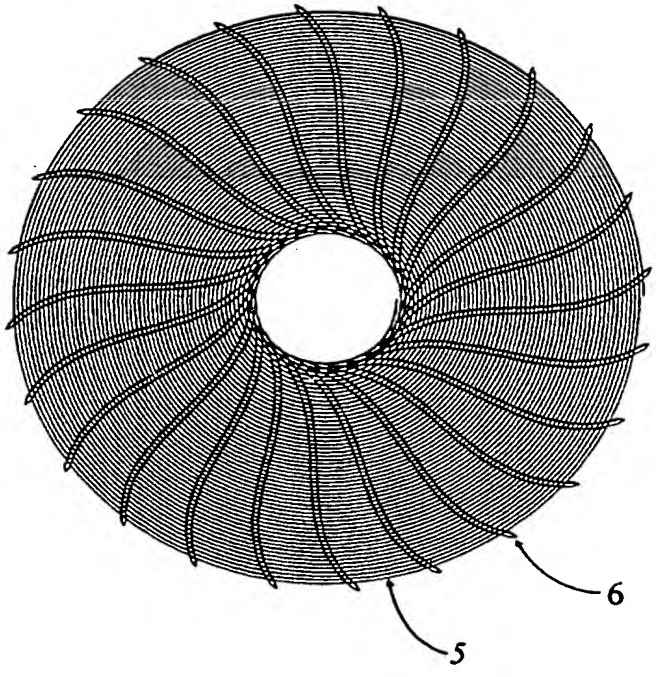

Fig. 3

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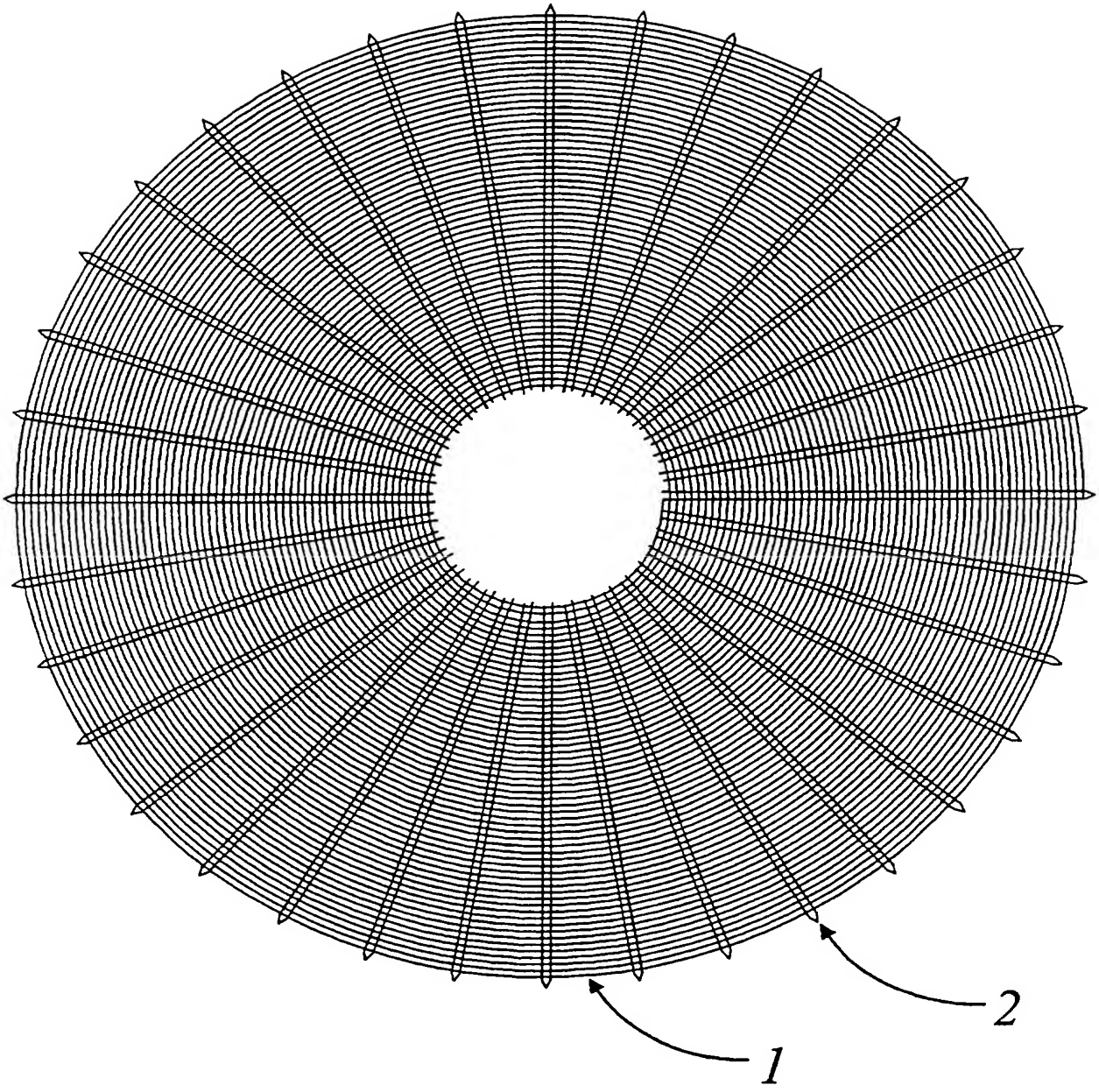

Fig. 1

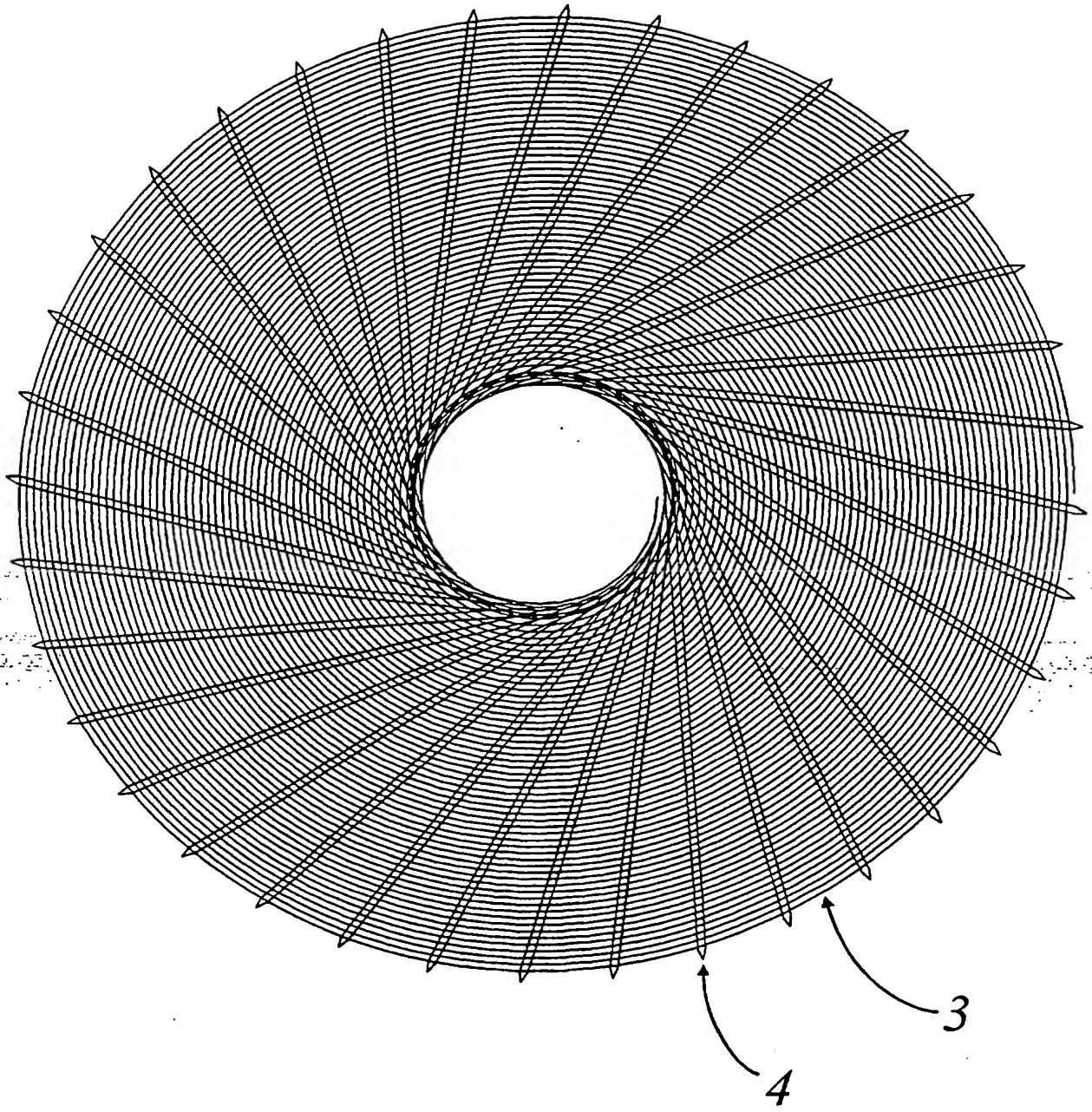

Fig. 2

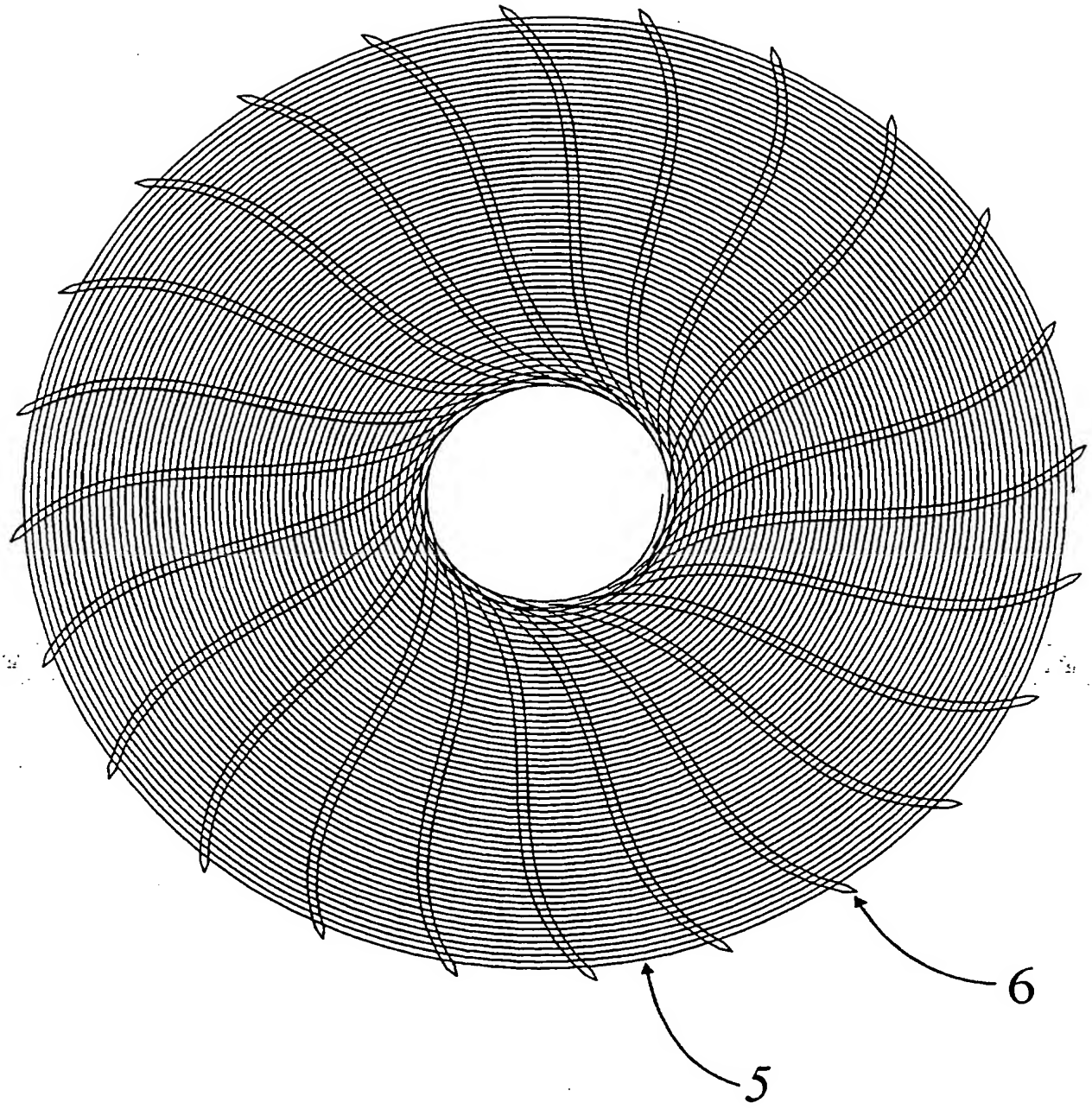

Fig. 3

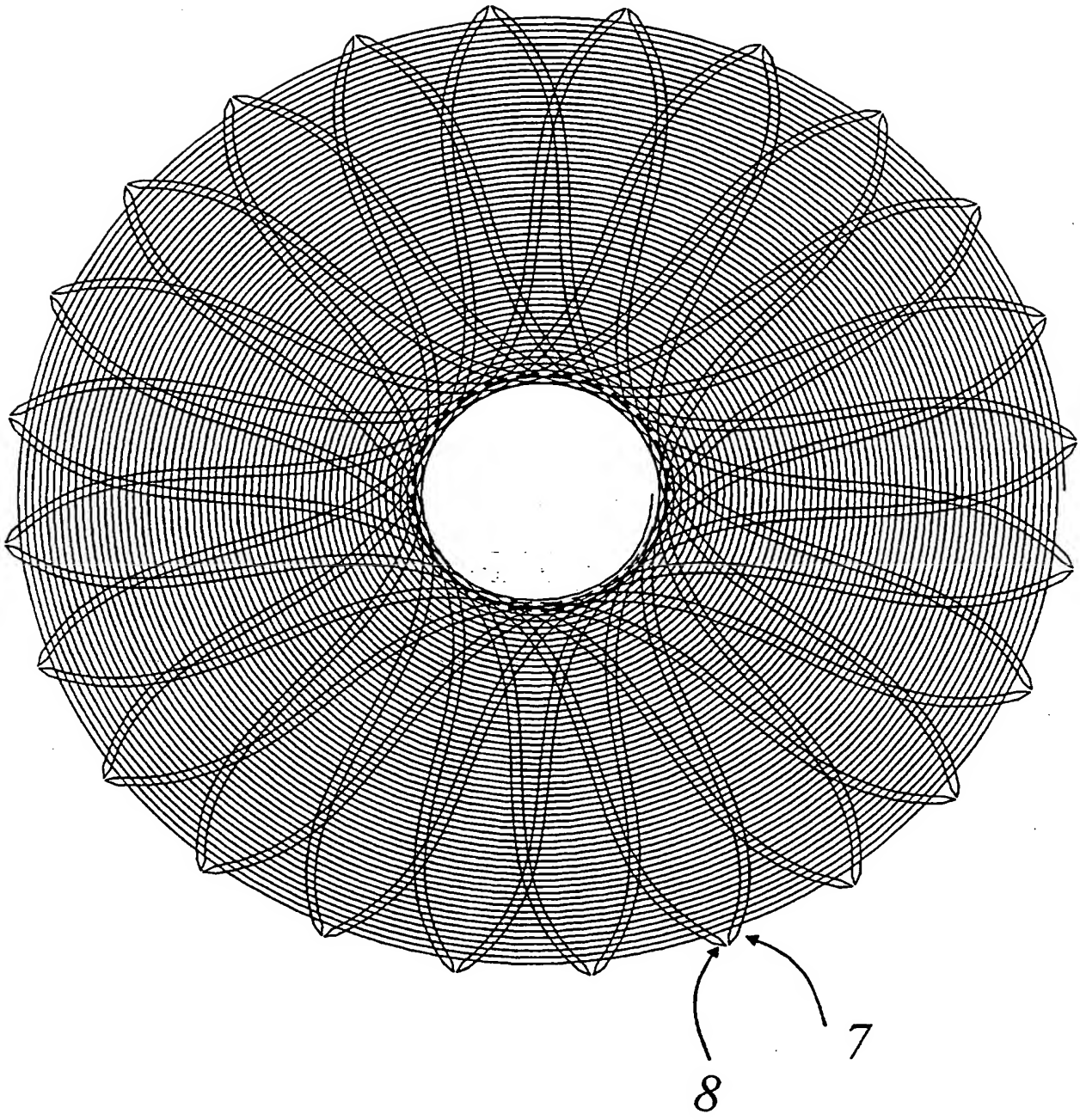

Fig. 4

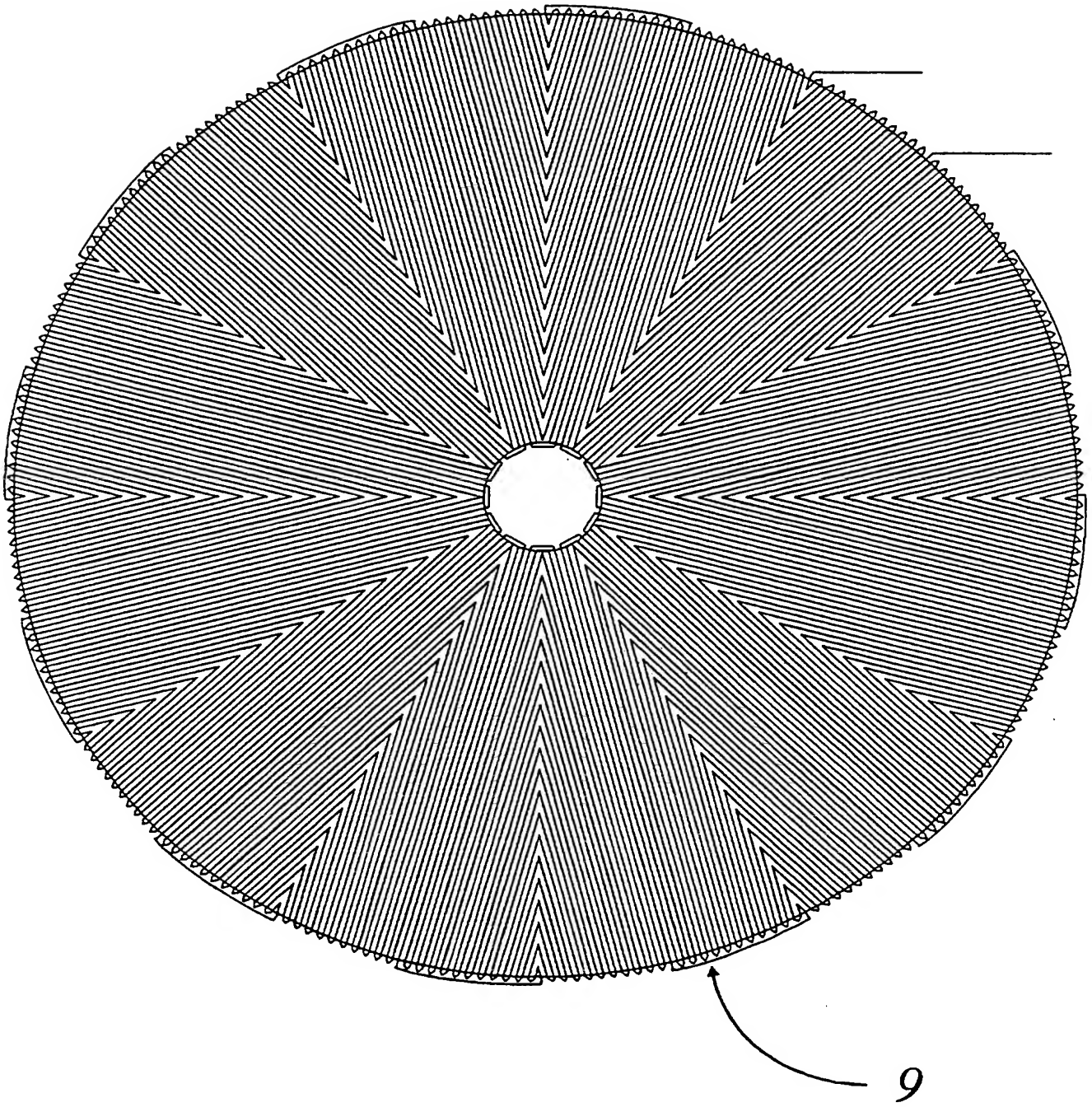

Fig. 5

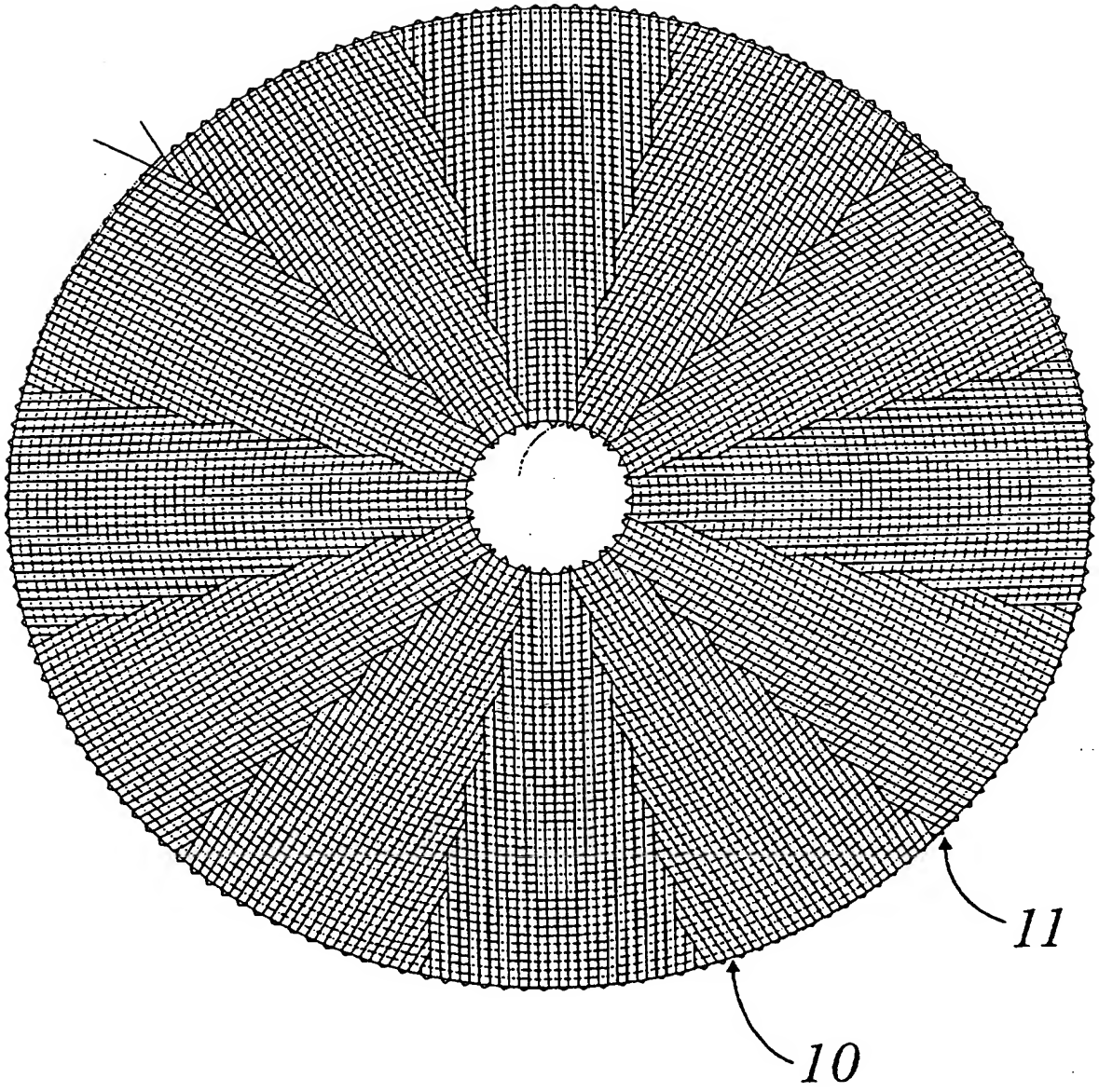

Fig.6

COMPONENTS FOR LOUDSPEAKERS

Components for loudspeakers, such as the cone, have been made from many materials. This application relates to the design and production of components from fibre assemblies produced by the techniques of embroidery.

Loudspeaker cones made from fibrous materials have been used widely, but those made from some methods of fabric construction have a number of shortcomings because of the restrictions of the raw material and method of assembly. For example, cones made from woven fabrics have to be cut from larger sheets of material, and holes have to be cut in the middle for the voice coil. The conical shape is usually formed from flat sheets of material and may be impregnated with resin of epoxy or phenolic or of other thermoplastic or thermosetting type before moulding into shape in a press or other tool. Cutting to shape can be difficult with some materials, and may be expensive.

The present invention provides for a novel method of manufacturing the material of the cone by forming fibrous material into the optimum shape by method of embroidery with the fibres oriented in directions selected so as to give optimum sound reproduction and make speaker assembly easier.

Embroidery is defined as work with a needle upon cloth, and has been known for centuries as a hand process. Within the last 150 years or so there have been developed processes for the automatic production of said embroidery.

Comparatively recent developments have added computer aided design to computer controlled operation of the embroidery machine. This has many advantages including that of consistency of product.

The process of embroidery has the objective of placing fibre in the positions required by the design of the product, whereas the use of woven fabrics generally require the intersecting fibres to be placed at approximately right angles to each other. Knitted fabrics are limited by the requirement for the fabric to be formed from a series of intersecting loops. However, embroidery techniques allow fibres to be placed as required, not having restrictions on their position forced upon the designer by the constraints of, for example, a bidirectionally oriented woven fabric.

One of the disadvantages of using an anisotropic or bidirectionally oriented material for cones is that vibrations produced by the voice coil reach the edge of the cone simultaneously and can be reflected back from the outer edge of the cone, producing unwanted resonances. By placing fibres where required by the use of embroidery techniques, such resonances can be minimised.

A computer controlled embroidery machine is effectively a pantograph placed under a sewing head. There are a number of types of sewing machine, and most of these can be applied to the technique of placing the fibres. The selection of the type of sewing head depends on the precise application and requirements for placing the fibres. For example, using the techniques that are possible using a Cornely type sewing machine, the principal reinforcing fibre can be wound externally and helically

by a wrapping thread and the wrapping thread stitched to the embroidery base cloth with a third sewing thread. On a lockstitch sewing machine a simple lock stitch can be used with one thread type used in the needle of the sewing machine and an identical thread or one of different type or construction as the underthread. The precise selection of technique and thread selection depends upon the requirements of the cone to be produced and the application for the loudspeaker to be produced, and the range of sound frequencies that it is required to reproduce.

The base cloth can be any suitable material, and the embroidery threads may be made from glass, aramid, cotton or other cellulosic material, nylon, polyester, polyethylene, polypropylene, carbon, metal or other material. In one embodiment of the invention, in a lockstitch sewing machine, both the needle thread and the underthread is an aramid fibre formed into a sewing thread of 120's count. The base material used is a water soluble polyvinyl acetate sheet. The possible arrangements of the fibres is virtually limitless and can for example, be radial, circumferential, linear or in layers or in any combination thereof. The density of the packing of the fibres can be progressively altered across the cone if required.

The technique is used primarily for producing and optimising the performance of cones both sonically and in respect of the lifetime of the product.

An example of the placement of the fibre on the base cloth is shown in figure 1 where there is indicated the pattern of the fibres embroidered onto a base cloth where 1 are fibres arranged in a spiral approximately circumferential around the

central hole of the loudspeaker cone, and 2 are fibres laid substantially radially from the central hole of the speaker. In figure 2 showing a different arrangement of fibres in a loudspeaker cone: 3 are fibres arranged in a spiral from the central hole and 4 are fibres arranged substantially tangentially radiating from the central hole.

In a further example shown in figure 3, 5 are fibres arranged in a spiral around the central hole, and 6 are fibres arranged approximately at right angles to those spirals in a curved shape which provides a different characteristic of sound movement from the central core.

Figure 4 shows a combination of the arrangement as shown in figure 3 with, superimposed upon it, a mirror image of that arrangement providing further different sonic qualities, where 7 are fibres from the mirror image radiating out and 8 are in the same configuration as shown in figure 3.

In figure 5, the spiral fibres around the central hole are not shown, but the substantially radial fibres are shown in a twelve section configuration where the fibres are still placed substantially radially from the central hole, but the twelve substantially triangular sections, one of which is indicated as 9, provide an opportunity for undesirable sound waves to be absorbed by the cone.

In a further example of an embodiment, figure 6, there is shown the fibres arranged in a mesh with fibres 10 being substantially circumferential with the mesh being completed by fibres 11 being substantially radial in a triangular configuration. Fibres

10 and 11 may be of differing thickness and stiffness, and the circumferential or substantially radial fibres can be made of low melting point fibre which can be later heated to provide a greater stiffness to some regions of the component than others. The base cloth upon which this embroidery takes place may be a woven acetate fabric which can be completely or partially dissolved away. If partially dissolved away in acetone, the residual acetate may be used in place of a resin to stiffen the component. However, the construction may be formed in such a way known to those skilled in the art, so that the construction is stable even after the removal of the base cloth which may be acetate, water soluble polyvinyl alcohol, or other base materials.

The technique can also be applied to the circular corrugated disk, known as a spider, that centres and controls the rear of the loudspeaker cone where it is attached to the voice coil in the magnetic gap: this device is known also to materially affect the sound quality.

Embroidery can also be used to make the central cones which are used to exclude dust from the voice coil and to acoustically terminate the centre of the cone; to make tweeter domes and also low frequency driver domes which are the same diameter as the voice coil and have no peripheral cone.

Embroidery techniques can also be used to add further layers to embroidered or conventional fibrous loudspeaker components, such as to provide peripheral, radial or tangential struts in the same or different material to further enhance or modify the acoustical properties of the speaker, for example by assisting in the break-up of

wave fronts from the voice coil, increasing stiffness of the coil in specific regions, or combinations thereof.

As another embodiment, the technique of embroidery can be applied to lay down conductive thread of metal or other conductive material such as metallised fibre, tape or other product in order to make the diaphragm and base plate driver for electrostatic or other types of directly driven magnetic or non-magnetic loudspeakers or combination speakers.

In a further embodiment a layer or layers of thermoplastic yarn, such as polypropylene, polyethylene, polyester or nylon can be interleaved with carbon, aramid, glass or other material of higher melting or softening point to give a yarn assembly which can be bonded to form a composite material by the application of heat which will melt the thermoplastic material to cause it to bond with the material of higher melting point to form a composite.

This method gives both a precisely controllable and repeatable fibre:resin component ratio which can be widely varied, and also resulting in a coherent preform easily placed and handled by the operator. For example it may be easily and precisely located in a mould by its central hole, particularly if an insert was placed into the mould to provide a location peg.

This method can also be applied to the production of speaker frames or baskets.

Claims

1. A loudspeaker component comprising a base cloth, and an array of fibres provided on said base cloth by embroidery.

2. A loudspeaker component as claimed in Claim 1 wherein said base cloth is soluble.

3. A loudspeaker component as claimed in Claim 1, wherein the fibres are arranged as a mesh.

4. A loudspeaker component as claimed in Claim 1, wherein the mesh is reinforced on at least part thereof.

5. A loudspeaker component as claimed in Claim 1, wherein regions of said mesh are of substantially triangular in shape.

6. A loudspeaker component as claimed in any of Claims 1 to 5, having fibres arranged to give greater stiffness in one direction than in another direction.

7. A loudspeaker component as claimed in any of Claims 1 to 5, comprising first fibres of a greater stiffness extending in one direction, and second fibres of a lesser stiffness extending in a second direction, the first and second directions of the fibres being substantially at right angles to each other.

8. A loudspeaker component as claimed in any of Claims 1 to 7, wherein the component is impregnated with a resin.

9. A loudspeaker component as claimed in any of Claims 1 to 7, wherein the component comprises a fibre which can be melted to provide stiffness to the component.

10. A loudspeaker component as claimed in any of Claims 1 to 7, wherein the component comprises a fibre which can be melted to provide greater stiffness to regions of the component than other regions.

11. A method of making a loudspeaker component, comprising placing an array of fibres on a base cloth by embroidery.

12. A method as claimed in Claim 11, wherein the base cloth is soluble and is removed by dissolving the base cloth in a solvent.

13. A method as claimed in Claim 11, when the fibres are arranged in a mesh.

14. A method as claimed in Claim 13, and comprising reinforcing the mesh in at least part thereof.

15. A method as claimed in Claim 14, wherein fibres giving a greater stiffness are placed substantially at right angles to fibres giving a differential stiffness.

16. A method as claimed in claim 14 wherein fibres giving greater stiffness are placed substantially radially to other fibres giving a differential stiffness.

17. A method of making a Loudspeaker component as claimed in any of claims 11 to 16 comprising first fibres of a greater stiffness extending in one direction, and second fibres of a lesser stiffness extending in a second direction, the first and second directions of the fibres being substantially at right angles to each other.

18. A method of making a Loudspeaker component as claimed in any of claims 11 to 16 comprising first fibres of a greater stiffness extending in one direction, and second fibres of a lesser stiffness extending in a second direction, the first and second directions of the fibres being substantially radially to each other.

19. A method of making a Loudspeaker component wherein embroidery is used to add further layers to any fibrous array of paper or textile.

20. A Loudspeaker component as claimed in any of claims 1 to 16 incorporating a conductive thread of metal or other conductive material applied by technique of embroidery.

The Patent Office

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Application No: GB 9803457.2 **Examiner:** Peter Easterfield
Claims searched: 1 to 20 **Date of search:** 19 May 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H4J (JDM, JED, JEX)

Int Cl (Ed.6): H04R 7/00, 7/02, 7/04, 7/06, 7/08, 7/10, 7/12, 7/14, 7/16, 9/02, 31/00

Other: Online: WPI, JAPIO, CLAIMS, INSPEC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 0479317 A2 (KENWOOD) see fig. 2	1,8,11,20
X	EP 0369434 A2 (KENWOOD) see fig. 6A	1,8,11,20
X	JAPIO Abstract Accession No. 02529695 & JP 630146595 A (FOSTER DENKI) 18.06.88 (see abstract)	1,6,11,14, 16

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.